Intro to AI

ITI0210, lecture 1 (2021)

Part 1: What’s AI?

My favourite classification

Weak AI:

- Solves one problem well

(the problem can be hard, like piloting a helicopter or becoming chess world champion)

Strong AI:

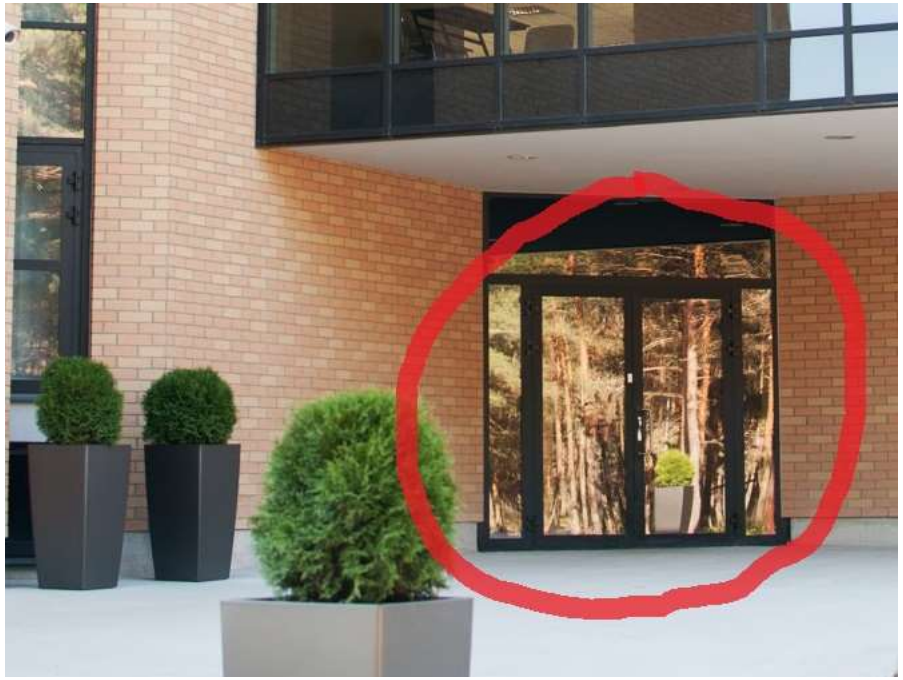
- Other names: HLAI, AGI
- Solve many different problems
- Generalize

(play football on a game console using knowledge from watching TV and playing in real life)

Weak or strong AI

Automated door

Human level AI (HLAI)?

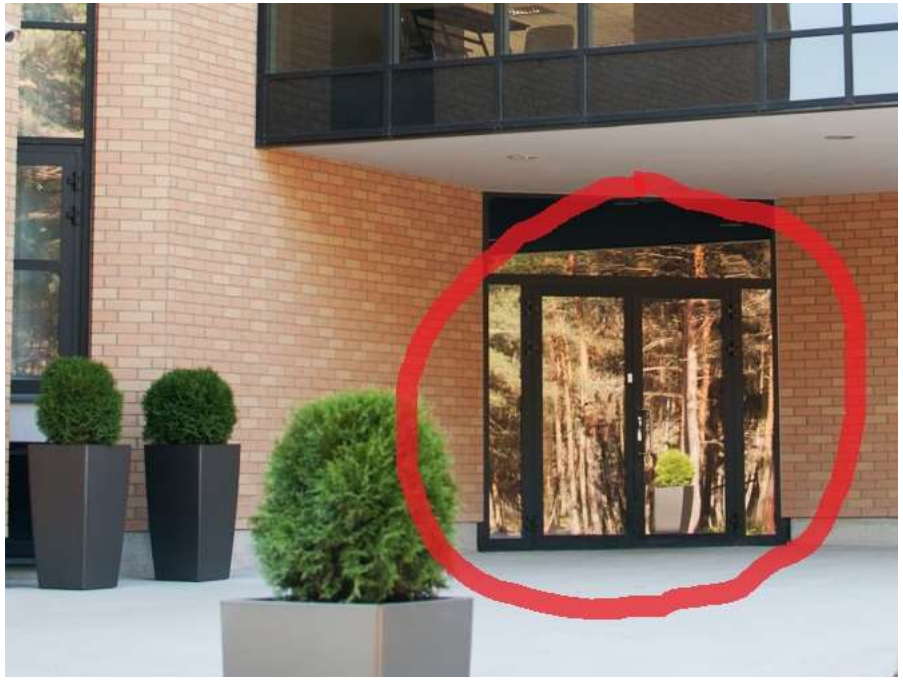


Weak or strong AI

Automated door

~~Human level AI (HLAI)~~

Nope (obviously)



Weak or strong AI

IBM Watson

(winner of Jeopardy! gameshow)

HLAI?

Image: Wikimedia Commons

Weak or strong AI

IBM Watson

(winner of Jeopardy! gameshow)

~~HLAI~~

Nope, can’t drive a car

Image: Wikimedia Commons

Weak or strong AI

AuveTech bus

(autonomous vehicle)

HLAI?

Weak or strong AI

AuveTech bus

(autonomous vehicle)

~~HLAI~~

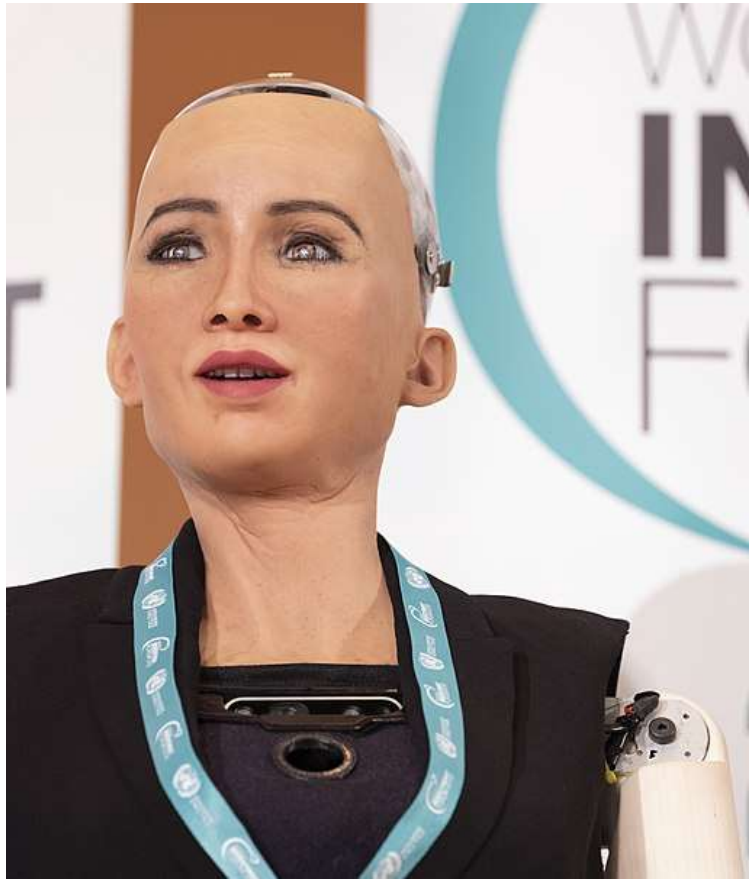
Nope, cannot talk to journalists

Weak or strong AI

Sophia

(robot, citizen of Saudi Arabia)

HLAI?



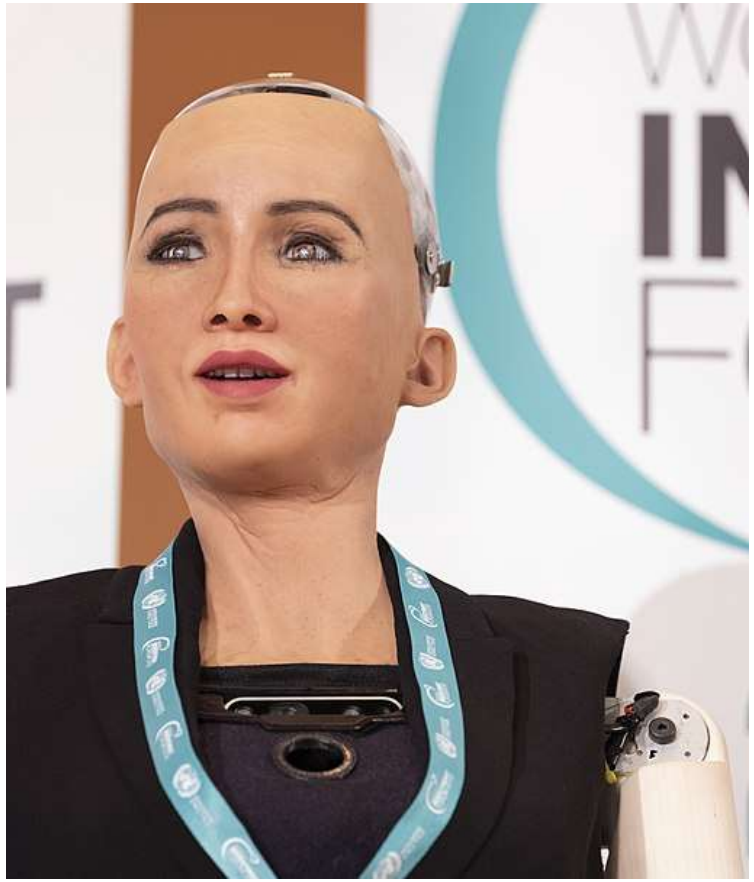
Weak or strong AI

Sophia

(robot, citizen of Saudi Arabia)

~~HLAI~~

No, cannot operate the door of U06A building



The point of the exercise

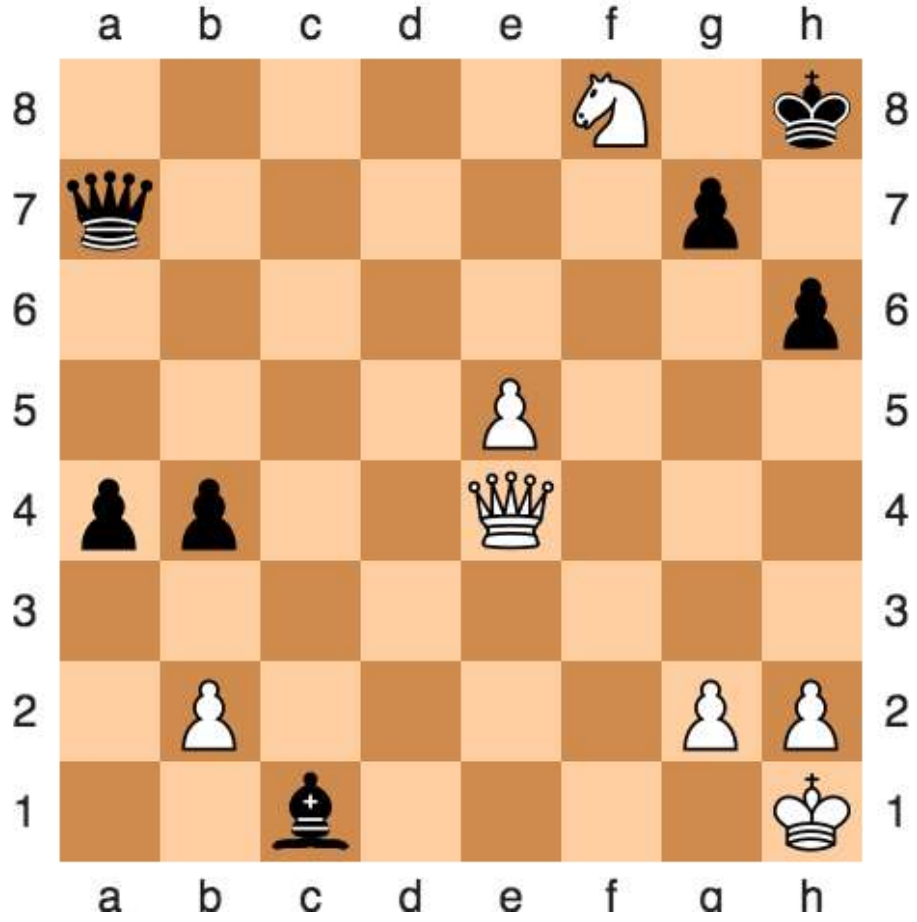
Current AI is **weak AI**

Individual algorithms and tools that do one thing
(and do it well)

Part 2: solved and unsolved

What’s hard for a human can be easy for AI, and vice versa

What's the best move?



Solved **beyond human level**

(position from Deep Fritz vs V. Kramnik, 2006)

Describe the scene

“black cat is sitting on top of suitcase."

Close enough!

(Karpathy, Andrej, and Li Fei-Fei. "Deep visual-semantic alignments for generating image descriptions." *CVPR* 2015.)

Commonsense reasoning

“*The trophy didn’t fit into the suitcase, because it was too big. What was too big?*”

“*The trophy didn’t fit into the suitcase, because it was too small. What was too small?*”

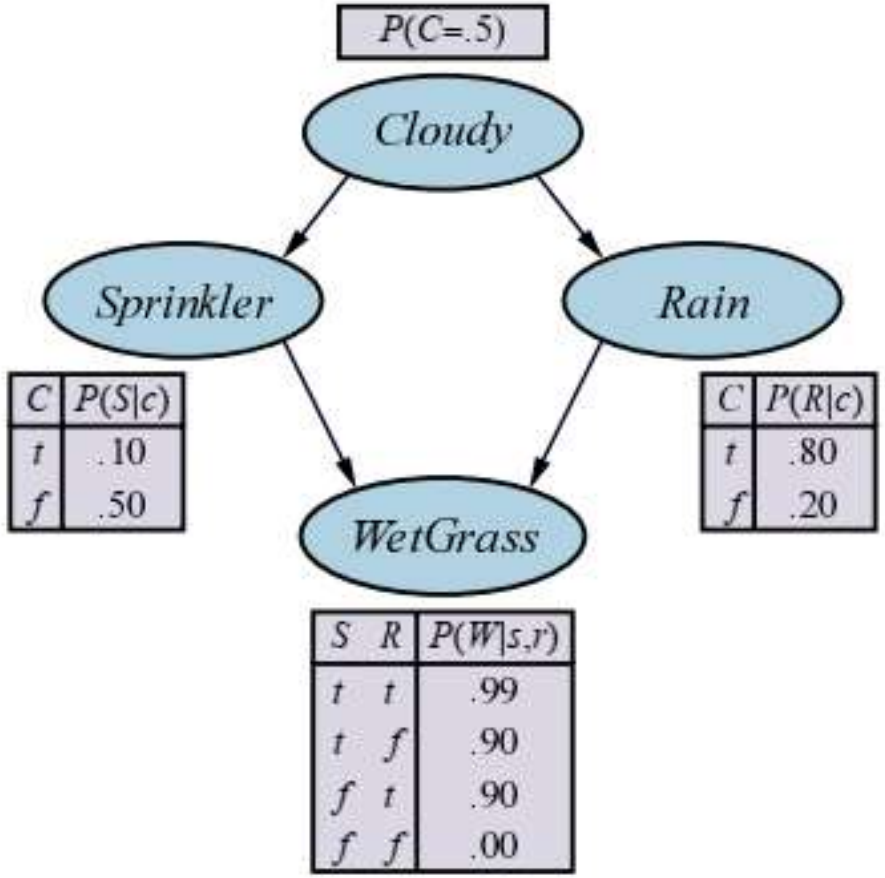
Remains unsolved in 2021

Part 3: Why is AI hard?

Example: probabilistic reasoning

- Variables: “Rain”, “Cloudy”, …
- Known causal dependencies
  - If “Cloudy” is true then “Rain” is true with probability 0.8
  - etc

Question: “*The grass is wet. What is the probability that it was cloudy earlier?*”



Example: probabilistic reasoning

Sadly, need to examine ALL POSSIBLE COMBINATIONS

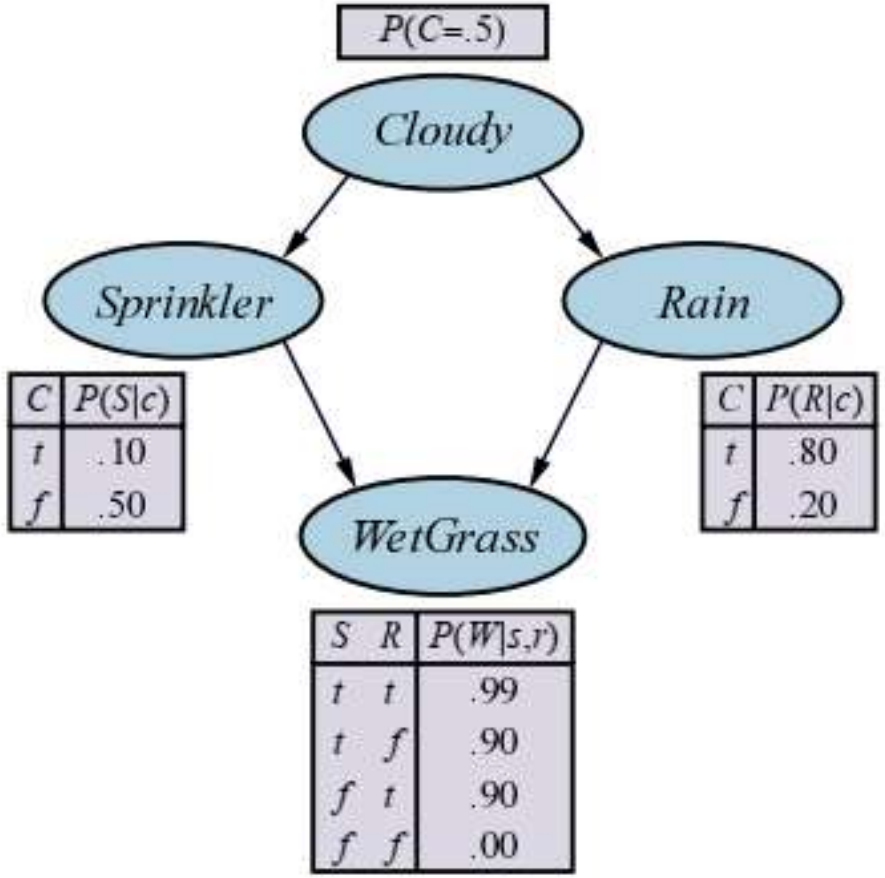
“Rain” = true, “Cloudy” = true, …

“Rain” = true, “Cloudy” = false, …

Etc

Here, just $2^3 = 8$ combinations (“WetGrass” fixed)

In general, d^n - n number of variables



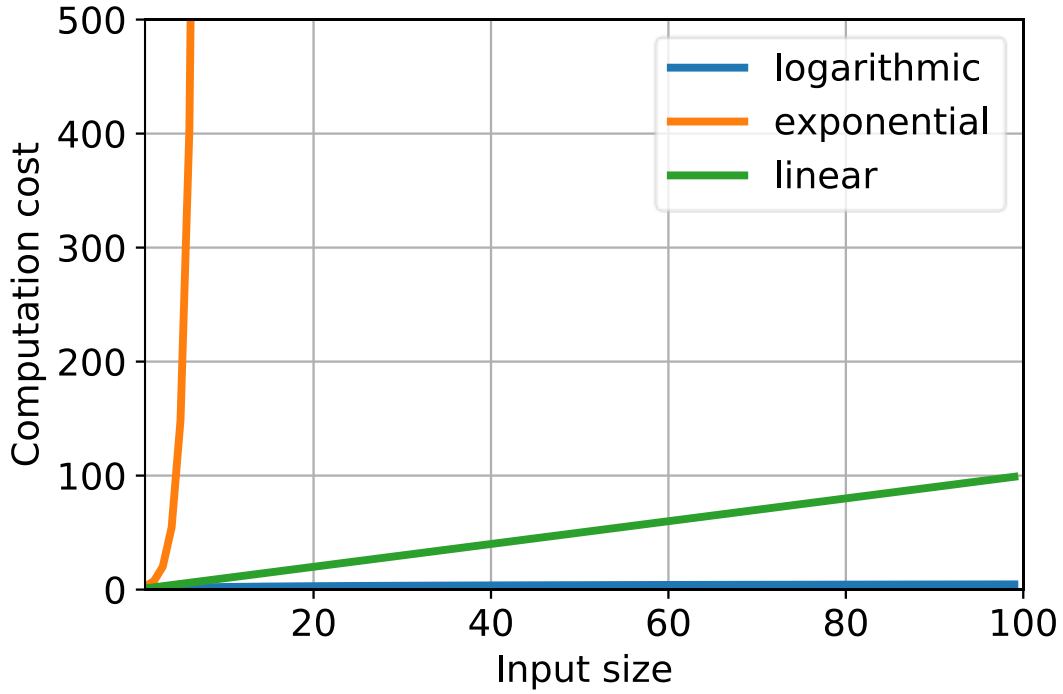
Computational complexity

Many AI problems are in class “**NP-complete**”

NP-complete problems are “**intractable**”, or hard to compute

- Solving requires exponential time and/or space

Computational complexity



Example task	Complexity
Index use	Logarithmic
List scan	Linear
Combinatorial search	Exponential
Optimization	Exponential
Probability model fitting	Exponential
Logical reasoning	Exponential

Part 4: Object of study

What parts of AI the course covers

In ITI0210, we study

- Main and classical algorithms
- Some mathematical background
- Toy problems

Example

What we study:

- Algorithms for two-player games
- How to represent a game in a computer program

What we don’t study:

- What’s the best tic tac toe program in 2021 and how to configure it?
- Will it destroy humanity?

Toy problem:

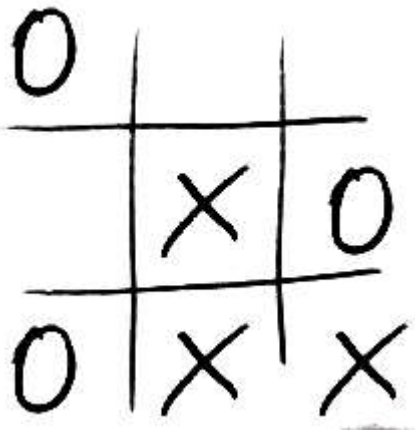


Image: Wikimedia Commons

Part 5: Rational agents

A useful concept from the AIMA book

Rational agents

"Intelligent agent"

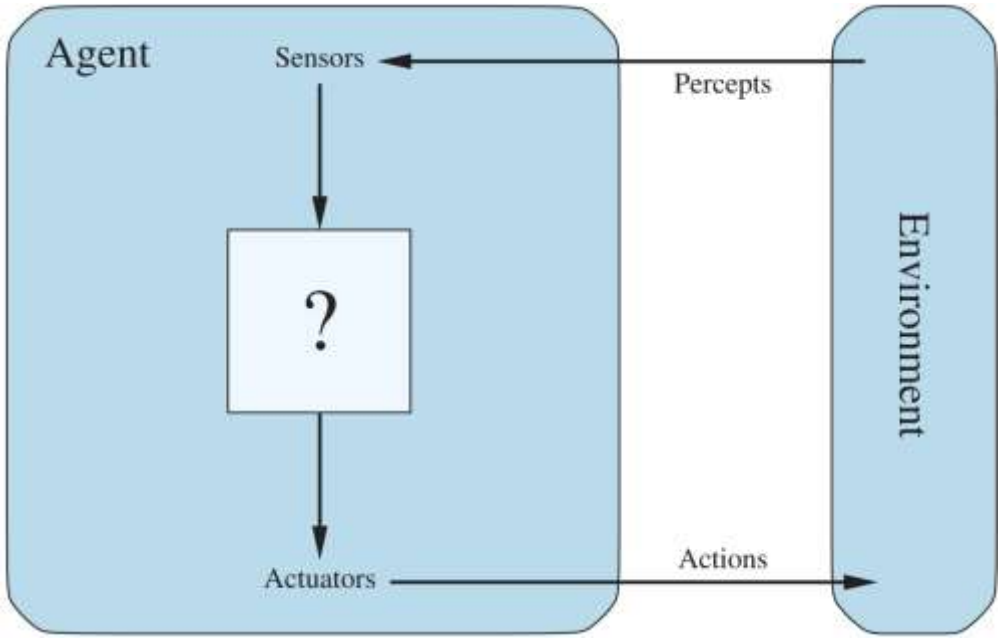
(could be a computer, program, robot, ML application…)

Image: Wikimedia Commons

Intelligent agent

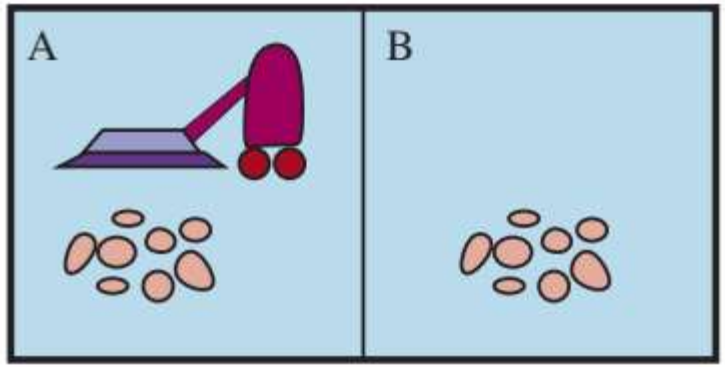
"?" can be

- Rules to decide action
- Algorithm to search for plan
- Machine learning model
- …



Intelligent agent example

The “vacuum cleaner world”



Agent: vacuum cleaner

Task: vacuum dust from rooms

Agent states: room A, room B

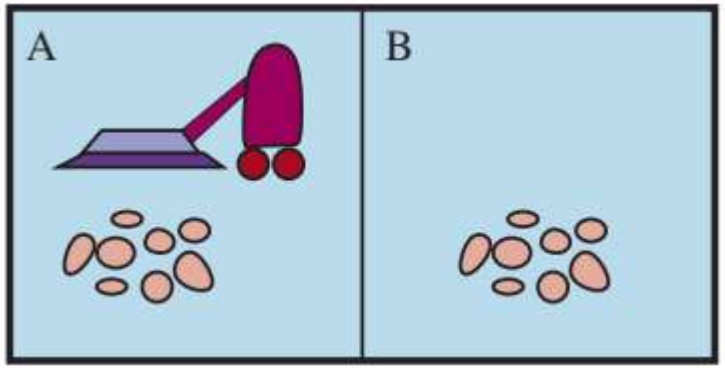
Room states: dirty, clean

Agent inputs: [room, room state]

[A, dirty]

Agent actions: Left, Right, Vacuum, NoOp

Simple agent program




```
def agent_action(location, status):
    if status == "Dirty": return "Vacuum"
    elif location == "A": return "Right"
    else: return "Left"     # location == "B"
```

Performance

Is our program useful? Need some performance measure

Example:

run agent for 10 cycles, measure energy cost

Action	Cost
Left	1
Right	1
Vacuum	1
NoOp	0

What if the world is changing (dust comes back)?

$$performance = cleanCountA + cleanCountB - totalEnergy$$

Rationality

Set goal for the agent:

Maximise Your Expected Utility

(borrowed from Nikita Kitaev, UC Berkeley, https://inst.eecs.berkeley.edu/~cs188/su20/)

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